The Exploration of Gingers in SE Asia – Some Milestones and Perspectives

Symposium keynote lecture

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The international symposia on Zingiberaceae are fora for the communication of new research and meeting places for all who are interested in Zingiberaceae and related families to exchange ideas and establish new contacts. Sometimes, it is also worthwhile to look back to former times and re-evaluate earlier researchers' works and to consider what we have achieved and what should be done. How can we, in the light of what has been done, do better in the future? How can we make the most of what are the available resources - human and economic. That is what I will try to do here today, hoping that it may be useful in our exchange of ideas during this meeting here in Singapore, which is and has been, for more than a century, one of the centres of research in taxonomy of Zingiberaceae in SE Asia, the region I know best and on which I will concentrate my speech.

One of the first scientific collections of gingers was made by the German medical doctor Engelbert Kaempfer who visited Thailand in 1690 on his way to Japan. We do not know much about his collections but Linnaeus described two small plants after him, *Kaempferia galanga* and *Kaempferia rotunda*. Linnaeus enumerated rather few species of Zingiberaceae in his *Species Plantarum* (1753), the starting point for botanical nomenclature. Besides these two species of *Kaempferia* we find *Zingiber zerumbet* which he referred to the genus *Amomum*, *Elettaria cardamomum* also mentioned as an *Amomum* species, and two *Curcuma* species, *Curcuma longa* and *Curcuma rotunda*, the latter now referred to *Boesenbergia*.

Johan Gerhard Koenig was another early explorer in SE Asia. He was German-Baltic by birth, studied for a few years under Linnaeus and became a Danish citizen before being sent as a medical doctor to the Danish colony Trankebar in India in 1767 where he undertook large collections. In 1779 he went to Siam and in 1781 to Ceylon. He became a good friend of Roxburgh who also looked after him during his last illness. He was one of the most important collectors in the 18 century even though he published little himself. He described 21 Zingiberaceae based on living material. The descriptions were sent to his friend Retzius for publishing in 1783. K. Schumann

characterized Koenig's descriptions as excellent. Koenig established 4 new genera, *Hura* (*Globba*), *Languas* (*Alpinia*) , *Hedychium* (*H. coronarium*) and *Banksea*, later changed to *Costus* and *Costus malaccensis* Koenig. His Siamese collections were mainly from the island Yunk Ceylon, not to be mistaken for Sri Lanka, it is what today is known as Phuket in Thailand. His large collection of manuscripts was, thanks to Roxbourgh, given to Sir Joseph Banks, and is now bound in 21 large volumes in the British Museum; herbarium specimens are found there and in Copenhagen. In literature at least up to 1980, and maybe later, we read that Koenig's collection from Siam was lost. They were, however, rediscovered in Copenhagen Botanical Museum some 20 years ago.

Real exploration of the family Zingiberaceae began in the 19th century with important works, such as Roscoe's Monandrian plants from 1828. Roscoe was an English historian, and a botanist in Liverpool. He was born in 1753 and became partner in a bank where he lost his money and became bankrupt in 1820. He was also the founder of the botanic garden in Liverpool. In 1824-28 he published his magnificent work*: Monandrian plants of the order Scitamineae*. It was issued in 150 copies, including 112 hand-coloured lithographs. He treated 66 species of Scitamineae most of which were cultivated in the Botanic Garden.

Important descriptions were undertaken also by Roxburgh at the Calcutta Botanic Garden and by his successor, the Danish born Nathanial Wallich (born Nathan Wulff in Copenhagen) who in his magnificent work, *Plantae Asiaticae Rariores*, published excellent illustrations of plants from British India including British Burma, among these several Zingiberaceae, e.g., *Kaempferia candida* and *Kaempferia elegans*, both described from Burma.

In the Dutch colonies, today's Indonesia, several botanists were active, among them C. L. Blume, a German born botanist, who worked for many years and collected several thousand numbers in Java at the beginning of the 19th century and later became director of the Rijksherbarium in Leiden. The Dutch botanish, Friederich Miquel, also made important contributions and described numerous species from SE Asia. He was a medical doctor from Groningen, and later director of the botanical garden in Rotterdam and professor in Amsterdam, finally succeeding Blume as director of Leiden Rijksherbarium from 1862. From the beginning of the 20th century, Valeton, another Dutch botanist educated at the university of Groningen, became one of the most important explorers of the Zingiberaceae mainly from Java. He first worked in Java at the Dutch sugar cane experimental station but finally became director of the herbarium in Buitenzorg, now Bogor. He took a great interest in Zingiberaceae and described numerous species with very careful and detailed drawings and descriptions from all over the region

as far eastward as New Guinea. His drawings are among the finest and most detailed in the family at that time and also his descriptions are extremely careful and precise. In his later years he worked at the Rijksherbarium in Leiden.

Another fine work from the middle of the 19th century is that of the Russian botanist, Paul F. Horaninov: *Prodromus monographiae Scitaminearum* from 1862. This work, although mainly a compilation of known literature, is still important for its time. He described species not only from Java, but also from New Guinea and other parts of the Dutch colonies in SE Asia.

The Italian botanist, Odoardo Beccari, is indeed admirable. He was born in Firenze in 1843 and died there in 1920. For more than 10 years he collected in Borneo, the Moluccas, Sumatra and Java, amassing several thousands of collections. He is perhaps best known for his extensive palm collections, though his zingiberaceous collections are as important. They are among the finest and most carefully prepared specimens found in herbaria. When one takes into consideration the extremely difficult conditions under which he worked in the field for months they are indeed excellent. They are today found as a special collection in the herbarium in Firenze where he became Director in 1876.

If we now try to summarize our knowledge towards the end of the 19th century and look at the comprehensive work of the De Candolles' *Prodromus systematis naturalis regni vegetabilis* we find the treatment of the Zingiberaceae from 1883. Here are enumerated 21 genera with in all ca 250 species. The largest genera are *Amomum* with 50, and *Alpinia* with 40 species, though the circumscription of *Amomum* does not correspond to ours.

Six years later, in 1889, we get an overview of the Zingiberaceae in a form that we can compare with today's systematics. That was done by a Danish systematist O. G. Petersen, a professor in Botany at the Royal Danish School of Forestry and Agriculture in Copenhagen, in the first edition of the "Die natürliche Pflanzenfamilien" edited by A. Engler and K. Prantl. Here, Petersen, who mainly worked with Neotropic Zingiberaceae, treated 24 genera with a total of ca 240 species including what we today recognize as Costaceae. Just to give an idea of how poorly the SE Asian tropics were known, the genus *Alpinia* was estimated to contain about 40 species, while we today recognize ca 250 species, whilst the other similarly large genus *Amomum* had 50 species including what we today treat as *Etlingera*. Finally the genus *Zingiber* was estimated to comprise ca 20 species, about one third of what we find today in Thailand alone.

The great breakthrough came with three botanists working about the turn of the century or around 1900, namely Schumann, Ridley, and Gagnepain.

I shall begin with Karl Moritz Schumann. The standard work on the family for about a century has been the large monograph on the Zingiberaceae from 1904 by Schumann in A. Engler's monumental world flora: "Pflanzenreich", in which he recognizes over 800 species. About half of these were described by Schumann himself from the German colonies in the eastern part of the area, New Guinea, and the Bismark Archipelago, but also from Borneo, Sulawesi and other areas. It is remarkable that in the 15 years from 1889 to 1904, the number of species almost tripled. In the subsequent 100 years we have been able to describe almost twice as many species. Holttum, in his treatment of the Zingiberaceae of the Malay Peninsula or rather Peninsular Malaysia, expressed a very critical attitude towards Schumann's work. This is impossible for me to understand and can only be caused by his anti-German feeling. Schumann's work is admirable even if we find today that many of the genera he treated have another circumscription than the one we now recognize. Let me add that in many works also in taxonomic literature we can read that Schumann's types were lost during the destruction of the Berlin Herbarium in World War II. That is true only for the herbarium material. The large collections of spirit material were miraculously saved and many types of Zingiberaceae are still preserved in the Berlin Herbarium in perfect condition.

In the French colonies several collectors worked all over Indochina in today's Cambodia, Laos and Vietnam. The same year as Schumann published his work, François Gagnepain wrote his account for "Flore Générale de l'Indo-Chine". He based his descriptions on very careful dissections and fine line drawings. In the herbarium in Paris we still find small envelopes with the material, the remains of his dissections, very often nicely arranged and glued to a piece of paper with fine pencil sketches. Gagnepain described Zingiberaceae not only from Indochina, but from all over tropical Asia.

In 1899, Henry Nicolas Ridley, Director of the Botanic Garden Singapore, published his account of the Scitamineae of the Malay Peninsula based on his own and several others' collections. He described more than 100 species, several of them from the botanical gardens in Singapore and Penang. But his contribution to the Scitamineae did not end with his work on the Ginger flora of the Malay Peninsula. He also contributed to our knowledge of the Zingibereaceae of Borneo in 1906 and the Philippines in 1909. He also described species from Indochina and Africa. All in all he described over 300 species. His work was critically discussed in the excellent paper by I. M. Turner, published in the year 2000, who writes, "His hurry to describe the myriad of undescribed taxa he encountered frequently led to scrappy, inaccurate, or even erroneous descriptions and nomenclatural and other taxonomic muddles. The mistakes Ridley made during his publishing career could probably provide all the examples needed for the International

Code. However, his achievements far outweigh his misdemeanours", a sentence that might also be applied to the two other great names, Schumann and Gagnepain. In this connection we should also remember the words of Airy Shaw, who in an article unveiled a mistake made by the founder of Flora Malesiana, the late Prof. Van Steenis, who described a new genus that turned out to be some monocot leaves mounted with a legume flower. Airy Shaw's conclusion was, "He who publishes nothing makes no mistakes".

The next great synthesis came with Loesener's contribution in 1930 to the second edition of "Natürliche Pflanzenfamilien". It is, naturally, based on Schumann's monograph with the same illustrations, but with a more "modern" approach to the generic concept.

Around the middle of the 20th century little was published except for Holttum's revision of the Zingiberaceae of the Malay Peninsula published in Gardens Bulletin Singapore in 1950. It was based on material available there and mainly collected by Corner in 1930-40. Holttum based his work on careful dissections of living material as well as on Ridley's collections. He paid much attention to inflorescence structures. His descriptions vary much in length and the drawings are often of little use as they are of a rather poor quality. His work is, however, still very useful when it comes to determination of species from the Malay Peninsula even if it also reflects the fact that Holttum, during the war, had very little access to literature that was not available in Singapore, something he was himself very well aware of and that he also told me during many fruitful discussions in the sixties when I worked in Kew and profited much from his knowledge. He expressed it once in the middle of the sixties in words along the lines of: "I wrote down what I knew about the Zingiberaceae of Malaya at that time".

Between 1970-90, B.L. Burtt and Rosemary Smith from Edinburgh did a remarkable amount of work towards a better understanding of the Zingiberaceae, not least of Borneo. In an early paper they dealt with the taxonomic history of the classification of the Zingiberaceae, in which they pointed out the many nomenclatural problems that exist and suggested solutions. Rosemary Smith contributed several revisions and a fine overview and a new classification of the largest genus, *Alpinia*, a work that is still respected in spite of later molecular work.

The latest overview of the family was published in 1998 in the "Families and Genera of Vascular Plants" edited by Kubitzki, following the tradition of Engler in the new century. Here I treated the Zingiberaceae in collaboration with J.M.Lock, M. and P. Maas, on the basis of what we knew at that time. It was just a couple of years before the turn of the century and the molecular age was just beginning. Two years later Kress and his collaborators published their new approach to the system of the Zingiberales and our knowledge took a turn towards a true phylogenetic

system. That is where we are today and what we shall hear much more about at this symposium.

Now we can ask the questions, what have we achieved? How deep or complete is our knowledge of the Zingiberaceous flora of SE Asia? Let us take a quick look at the regions.

I have concentrated in this lecture on SE Asia, but I shall just mention with a few words the situation on the Indian subcontinent where Indian botanists are now contributing greatly. I am also sure that even if India belongs to a part of tropical Asia which has been rather well studied botanically for three centuries, there are still many areas in which undescribed taxa will be found as we have recently seen, e.g., from the Nicobar Islands, and the vast mountainous regions in the extreme north and northeast.

If we move from India towards the East the next country we meet is Myanmar. This was included in Hooker's "Flora of British India" but was far less collected than India. Today it is hardly possible to do serious collecting work in Myanmar due to the political situation, as the most interesting areas cannot be reached. I am, however, not in doubt that when the time comes that we can freely move around in Myanmar, many new taxa will be found. During my work with the genus *Caulokaempferia* I have seen material collected by George Forrest from the frontier between Myanmar and China representing more that one undescribed species, but the collections are too poor to be described properly. Undoubtedly, some of the old taxonomists would have described these as new species. Still new species have been described as, e.g., *Smithatris myanmarensis* W.J. Kress and *Mantisia wardii* Burtt & Smith. All in all the number of species documented from Myanmar is ca 150 and that is according to my experience very low. There is, in my opinion, no doubt that twice as many species occur in that country.

Let us turn to China where we have a new revision. China is a country where taxonomy has a high priority as a basic science strongly supported by the Academy of Science and the government. Chinese botanists are in these years doing an enormous amount of work collecting, describing and publishing. The great partnership between the Missouri Botanical Garden and the Chinese Academy of Science, which is producing the second edition of the Chinese Flora, now in English, is admirable. I co-authored the Zingiberaceae myself with 216 species in 20 genera. 141 species or over the half are endemic. This contribution was published in year 2000. In the same year my co-author, Dr. Wu Te-lin published one new species of *Alpinia* from the Guangdong province and more have been found since. We have also found recently that some of the supposedly endemic species also occur in Thailand and others will probably be found in northern Vietnam. So collecting gingers in the hilly southern tropical provinces of China is far from complete even if we may regard China as, probably the best studied country

from a Ginger specialist point of view. Also in year 2000 a new species of the hitherto monotypic genus *Vanoverbergia* was found and described by Funakoshi and Ohashi from Taiwan.

The Indochinese countries, Cambodia, Laos and Vietnam, were treated together by Gagnepain in the "Flore générale de l'Indochine" in 1908. Comprehensive collecting of Zingiberaceae has not been undertaken since the publication of that Flora in which 12 genera with, in all, 102 species were recognized; 62 of which were described by Gagnepain. From the numerous unnamed collections in Paris on which I worked with in the 60s and 70s, I described several new species but it was also clear that much old material was inadequate for describing. For several decades it has not been possible to travel to and in these countries. Fortunately the situation has completely changed and a new generation of botanists is now working seriously in exploring these countries with international cooperation, e.g., between Russian and American taxonomists and the National Museum in Hanoi.

From this fruitful partnership between the herbarium in St. Petersburg and Hanoi, the Orchids have been treated. I have seen photographs of numerous unknown Zingiberaceae collected in the north of Vietnam where the limestone region seems to be particularly rich in species. From the central limestone region of the country, Mark Newman several years ago described the new genus *Distichochlamys*. A few years ago a Russian zoologist found a second species, and immediately after, a third species was found. From Laos a beautiful little *Curcuma*-related plant was found by Dr. Jenjittikul at the Chatuchak flower market in Bangkok where loads of plants are brought from across the border at the Mekong River. We described this as *Laosanthus graminifolius* .The plant is now found in nurseries in the USA. Today we have documented over 200 species from these three countries, the question is then, "is the flora of these three Indochinese countries less rich than the Thai flora with 300 species?" I do not think that, and I believe that another 100 species will be added when the rich plant communities, particularly of Vietnam and Laos, are properly explored.

Peninsular Malaysia and Singapore are, as China, well studied botanically, but still new species are found. A beautiful species of *Haniffia* was recently refound and it was suddenly possible to solve a question about the occurrence of the genus in Thailand, first posed by Holttum. The plant mentioned by Holttum is not a *Haniffia*, but at the same time I collected a second species from Thailand. A few years ago we published a popular booklet, which gives an overview of the ginger flora. The time has come, however, where a full treatment of the Zingiberaceous flora of Peninsular Malaysia should be published. I am here thinking of a book similar to that of Gunnar Seidenfaden & Jeffrey Wood: The Orchids of Peninsular Malaysia

and Singapore. With the tradition of ginger research in the Singapore Botanic Gardens going back to Ridley and Holttum, it would be a fine way to commemorate these two pioneers.

From these more or less well documented countries we shall move to a region which is far more difficult to overlook. Coming from Peninsular Malaysia it might be natural to continue to Eastern Malaysia: Sarawak and Sabah. Here the situation is different. There are still vast areas to explore as seen from the many new species described of, e.g., *Boesenbergia*, *Zingiber*, *Etlingera*, *Alpinia,* and the new genus, *Tamijia.* This last genus was found by molecular studies to constitute its own subfamily Tamijioideae. There is still a vast field for exploration in this part of Malaysia and I have no doubt that many new taxa will be found on each new collection expedition there.

Indonesia is even more difficult to deal with, even though we now have an excellent overview in the checklist published by Newman, Lhuillier and Poulsen from 2004 covering the whole Malesian area. This vast country is centred around the island of Java with one of the best documented floras of the region, not much new could be expected from the national parks here. Quite different is the situation in Sumatra, which is one of the islands that should attract more attention. Several new *Globba*s have been described and I am aware of new *Boesenbergia* species which cannot yet be described due to the poor state of the existing material. This is indeed a problem with ginger collections made by general collectors who do not know how to preserve or describe the delicate structures of these plants. East of Java the challenge becomes even bigger. Few genera have been revised as, e.g., *Burbidgea*, endemic to Borneo. When I say Borneo it is strange that it seems that there are far more gingers in the northern and eastern Sarawak and Sabah than in Kalimantan. I am not in doubt that this is more due to lack of collecting than to phytogeographic peculiarities. The more we go East in the Malesian region the poorer is our knowledge. New Guinea and the Bismark Archipelago have not been visited for decades by systematic collecting expeditions concentrating on Zingiberaceae. We are here practically at the same level of information as 100 years ago when Schumann published his work. His short descriptions are often difficult to evaluate. Just to give an idea of the situation let me mention the genus *Riedelia* with about 100 species, which has never been revised and with numerous species only known from the type locality. In the genus *Plagiostachys*, much of the old materials are useless as the flower structures in many species cannot be seen due to the deterioration of the inflorescence in a slimy substance after flowering. Even though a survey of the Bornean species was published by Rosemary Smith in 1985, we know that it will be a long time before a revision can be written. What I have said about these two genera could be repeated in the case of *Pleuranthodium.*

The Zingiberaceae of the Philippines were treated by Ridley in 1909 based on specimens in the herbarium in Manila and the numerous collections made by Elmer and Merrill and also the classic collections by Haenke, Cuming and Blanco. Again here many species are only known from the type locality or very few collections.

Let me end this very short presentation of the SE Asian regions with a more comprehensive review of the status of Thai Zingiberaceae, the area I know best, and a flora with which I have worked for half a century. I still remember my first collection of the family from SE Thailand in January 1958. My field notes read, "small, terrestrial orchid with green flowers". It was a *Gagnepainia*.

At about 1960 our knowledge of the Zingiberaceae was mainly based on the old ollections of Koenig from Phuket, Johannes Schmidt from Koh Chang, and the Kerr collections. All in all about 70 species were documented.

In 1980 I published the first annotated key to the genera of Zingiberaceae in Thailand. Here the number of species is estimated to ca 150. In 1996 I then published a preliminary list of species and the number had reached 200. In a newly published book, K. & S.S. Larsen 2005, "Gingers of Thailand", we have documented over 300 species, among which are also new endemic genera. To some of you the history of these is well known, but I still find it very important to mention it as it shows how much there is still to do all over SE Asia.

But, first a word about *Caulokaempferia.* In 1964 I described the genus *Caulokaempferia* based on a group of species formerly treated as *Kaempferia's.* In the following years more species were described and 10 years ago five species from Thailand were known. Today the number has reached 18. We shall hear even more exiting news about this genus later today.

Few years ago my friend and collaborator, John D. Mood, came to me with two specimens that did not match any known taxon. One was collected in Southern Thailand on the mountains bordering Malaysia. We described that as *Siamanthis siliquosus*. Molecular studies have shown that it may be related to the Bornean genus *Burbidgea*. Its long silique-like fruits are, however, similar also to those of *Siliquamomum tonkinense* from Vietnam. The other plant Mood brought to me looked like a *Kaempferia* but with a yellow *Zingiber*-like flower. I had indeed myself a colour slide of this plant given to me years previously, but I had never been able to identify it. It was a plant that was in the trade in the USA under the name *Boesenbergia aurea,* an illegitimate name as it is a later homonym. That, we also described as a new genus, *Cornukaempferia aurantiflora*. Shortly afterwards a second species turned up and now we have a third species which is about to be

published. Molecular studies have shown that it is related to *Zingiber*. The third new genus described in the last 5 years is *Smithatris*. It has an even stranger history. During an earlier *Heliconia* meeting in Singapore a plant was shown that had an inflorescence showing resemblance to a *Curcuma* and leaves with the look of a Marantaceae. John Kress and I described it as *Smithatris supraneeana* commemorating the late Miss Rosemary Smith, and at the same time Mrs. Supranee Kongpitchayanond from Thailand, who first presented it from her nursery, and thus brought it to scientific recognition. No botanist had ever collected this spectacular plant even though it grows commonly in a small limestone area just north of Bangkok, an area exploited by a cement factory. Furthermore it has been used since time immemorial by the local people to bring to the temples during the celebration of the Bhuddist Lent, often together with *Globba*'s. Strangely enough the year after the Director of the Queen Sirikit Botanical Garden in Chiang Mai, Dr. Weerachai Nanakorn, had bought some rhizomes at a market in Myanmar where he was attending a conference, one of these collections turned out to be a second species, which had almost simultaneously been collected in the wild by John Kress also in Myanmar. This species was described as *S. myanmarensis*. So, three new spectacular new genera described over the last five years.

But also the number of species in the larger genera found in Thailand has astonished us. Two genera illustrate this: in my checklist from 10 years ago I estimated the number of *Zingiber* species to be ca 25. At that time I had a Danish Ph D student who undertook a revision of the genus; she came to the result that the number was 26, but that there were probably two or three undescribed species. Dr. Ida Theilade, however, became engaged in a different line of research and handed over her material to Dr. Pramote Triboun from the Bangkok Herbarium who then started a thorough collecting programme all over the country for three years. We now know, as we shall also hear later, that there are over 50 species of *Zingiber* in Thailand.

A similar result was reached by Dr. Charun Maknoi who has worked for years on the genus *Curcuma* where over 10 new species have been discovered during the last few years, some by John Mood and myself, some by Professor Puangpen Sirirugsa, others by Dr. Maknoi. Besides all the new species, many of the species treated as endemic in the Flora of China in the year 2000 have now been found also to occur in northern Thailand.

So much for the Flora of Thailand, which we regard as one of the better known regions in tropical Asia. Let me finally add that the genus *Amomum* in our checklist in "Gingers of Thailand" comes up to 16 species but according to a team of Thai botanists working on a revision of this genus the number may be twice as high.

I have tried here in this short overview of the history and the progress

of exploration of the zingiberaceous flora of SE Asia to give you an idea of how far we have reached and how much we still do not know. And then the questions come, "What are the priorities of research in the future? Should it be molecular studies or should we go out and collect more, or are there other fields that need to be explored?"

I find that there are three equally important fields:

1. The molecular approach has been shown to be important for a better understanding of the generic boundaries and relationships between species and the evolution of the Zingiberaceae as a whole. It has brought us a big step forward. This is laboratory work that must be based on a sound knowledge of the identity of the taxa. And even if there is still much to do it seems to me that the cream has already been skimmed off the milk.
2. Alpha taxonomy is important and it seems that we are, at the present time, exploring the last unknown frontiers of SE Asian biodiversity. New collectors to the region should be aware that expeditions visiting a tropical country are often taken to the so-called interesting localities by local botanists. This is where collectors have grazed repeatedly - and we know from Thailand that it is outside these areas that all the new discoveries are made.
3. Finally, there is a field that is much neglected: ecological and biological studies. Pollination and dispersal biology are unknown in the majority of species, even the fruits and seeds of many species are unknown. Here local botanists have a vast research field. But it seems that there is more prestige in being in the laboratory in a white coat and working with a big computer than getting out in the jungle.

Is there anything we can do here at this meeting to speed up the exploration of gingers? As funds are limited it might be a good idea to establish a kind of advisory board for Zingiberaceae reseach, a group of experienced local people who could point out areas to which collecting activities should be directed, taking also regional political aspects into consideration. Furthermore organizing research groups of young botanists with a strong scientific leadership that could attract funds. These activities might be facilitated through a newsletter, probably electronically distributed. These could be the ways to bring us forward by working together and avoiding duplication of research. If we can agree here on broad collaboration, to be open in our research and respect each others work, then, this meeting will be a big step forward and not only a statement of our knowledge today.